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ELECTRIC FAN

Field of the Invention

This invention relates to electric fans or blowers which may be used in, for instance, domestic, medical, commercial, industrial and transport applications.

Reference will be made hereinbelow to ventilating fans for causing air to be expelled from a space, for instance, from a kitchen. Such fans may be wall, window or duct mounted so that the air is expelled from the kitchen or other space to the exterior of the building. However, it should be appreciated that the present invention may be embodied in all sorts of different pressure and suction fans and blowers and, more generally, to fluid moving devices, for example circulation devices, in which the fluid is a gas or a liquid.

Background to the Invention

Ventilating fans are known which may be of the centrifugal or axial variety. In general, they are rather inefficient devices and there is a need for a ventilating fan which can effectively shift large volumes of air with low electric power requirements. Existing fans have components such as a motor, electronics and connectors, that, because they are positioned in the path of air passing through the fan, are vulnerable to dust, grease and other contaminants. These contaminants cause reduction in life expectancy of the components and make them difficult to clean.

An attempt to deal with these problems involves the provision of some form of device to pre-filter the air and such a device adds to the cost of the fan and itself has maintenance requirements.

Accordingly, there is a need for a ventilating fan which can be easily disassembled, at least to the extent that its front cover may be removed to allow the consequential easy removal of the various moving parts, for instance, the impeller. Once these moving parts are removed, smooth, rounded internal surfaces are more easily cleaned.

Statements of the Invention

According to the present invention there is provided an electric fan comprising a housing body, a front cover defining a fluid inlet to the housing and a rear fluid outlet aligned with said fluid inlet, a motor and an impeller mounted within the housing between said inlet and outlet for drawing fluid into the housing in a direction from said inlet towards said outlet in an outwardly radially direction before exiting via the outlet, the front cover being moveable relative to the housing to allow access to said impeller and motor.

The fact that the front cover is moveable relative to the housing body enables easy access to the components of the fan for servicing and cleaning purposes. The front cover may, for example, be hinged to a wall of the housing body.

In a more preferred embodiment of the invention the front cover is removable. For example, the front cover is attached to the housing by screws or a snap fit-mechanism or is slidable relative to the housing body. Even more preferably the front cover clips onto the housing body about their peripheral edges.

In order to increase the safety aspect of the fan the movement of the front cover effects isolation of the motor and thus ensures that it is not possible to run the electric fan in an unguarded state.

Once the front cover has been moved or removed to allow access to other components within the fan, such as the impeller, hub, motor mount, air collector, driver or duct adapter, these components can be simply cleaned *in situ* using an appropriate cleaning solution, for example warm soapy water.

In an even more preferred embodiment of the invention the impeller is removable from the electric fan and can be thoroughly cleaned by immersion in an appropriate cleaning solution, for example water soapy water. This avoids the problem of unsightly fans with clogged filters. Preferably the impeller is removable from the

housing by relative movement along the axis between the fluid inlet and the fluid outlet.

Any un-removable components exposed within the fan by the removal of the front cover and/or impeller are preferably designed and arranged such that plain surfaces are exposed allowing easy cleaning with, for instance, a damp cloth. Furthermore such components, for example, the motor, the drive and the controls, are preferably sealed from dust and water spray, which makes them not only easy to clean but also both hygienic and safe. Accordingly, a fan of the present invention may have all those components which are vulnerable to contamination by dust, grease and other contaminants, encased in protective chambers, thereby avoiding the problems mentioned above in connection with existing electric fans. Cleaning is fundamentally easier and quicker and life expectancy is extended. Furthermore, the requirement for a device to pre-filter the air is eliminated.

In a further preferred embodiment of the invention the components of the fan are co-axially arranged along an axis extending between the fluid inlet and the fluid outlet such that removal of a first component by movement along the axis facilitates access to a second component. For example, removal of the front cover enables access to the impeller, removal of the impeller enables access to the motor mount, removal of the motor mount enables access to the motor and so on.

In an alternative embodiment of the invention the components of the electric fan are concentrically arranged along the axis.

In a still further preferred embodiment of the invention which further includes a means to collect the radially directed fluid and direct it towards the fluid outlet, the collecting means being a plurality of collection chambers.

Preferably the collection chambers are circumferentially spaced about said axis. Preferably, the collecting means is a plurality of helical conduits, each having a circumferentially disposed inlet and axially disposed outlet.

The provision of multiple collecting chambers to receive air from a rotating impeller allows significant reductions in space for a given performance, and without reduction in efficiency, compared with a conventional fan.

In a preferred embodiment of the present invention, the fan is provided with a humidity sensor and means for automatically increasing the speed of the fan in response to a predetermined increase in the humidity of the fluid passing through the fan.

The inclusion of a humidity sensor in a fan of the present invention allows the fan to be responsive very rapidly to a situation requiring effective operation of the fan. Such situations may include the running of a bath or shower in a bathroom or the cooking of a meal in a kitchen. The fan can be running at a relatively low speed (standby operation) with a very small flow rate passing through it. As and when the humidity sensor detects a sufficient increase in the humidity of the air passing through the fan, the speed of the fan may be automatically increased. In this way the fan will be "in control" of the local environment at all times. As soon as any increase in local humidity is dealt with, the fan will quickly and automatically revert to standby mode.

If the "non-local" environment is itself both warm and humid, the above described system, incorporating a humidity sensor, would result in the fan continuing to operate at an increased flow rate. To deal with the situation, an "outside" humidity sensor can also be installed along with appropriate circuitry to compare humidity both "locally" and "non-locally".

A fan in accordance with the present invention may be one which can operate at two speeds, a low speed or trickle mode and a higher speed or boost mode. When fitted with a humidity sensor as described above, the fan may be provided with a variable speed function to match the rising or falling humidity. The above described fans are provided with a housing body or rear carcase which is an easy to fit, maintenance-free item which never needs to be removed from the wall to which it is secured. A

fan in accordance with the present invention may be small enough for bathroom installations but with more than enough power for kitchens. Small power consumption is achieved through the use of a self-regulating, whisper-quiet, DC electronically commutated motor. The fan is filterless. The internal design gives air management which forces dust and contaminates away from the sealed electric motor, pushing it past internal smooth surfaces to the atmosphere, thereby avoiding the need for a filter. As the motor is protected from noise-inducing, power-draining dirt and grime, it remains quiet, efficient and economical throughout its life.

At the heart of the fan is located the above described helical power expansion chamber which moves large volumes of vapour-laden and/or contaminated air, all within the confines of a small piece of equipment operating with great power efficiency.

It will be understood that the electric fan of the present invention can be an extract fan, pressure device or circulation device. Preferably the fluid is air.

In an alternative embodiment of the invention the electric fan is a pump for a liquid.

There is also provided a fan assembly comprising two or more electric fans according the invention wherein the fans are mounted within a common housing.

There is also provided an appliance comprising an electric fan according to the invention, for example a domestic appliance.

Brief description of the Drawings

The invention is illustrated, by way of example only, by the embodiments shown in the accompanying drawings, in which:

Figure 1 is a front view of an electric fan in accordance with the present invention;

Figure 2 is a side view of the electric fan of Figure 1;

Figure 3 is a section on line AA of Figure 1;

Figure 4 is a section on line BB of Figure 1;

Figure 5 is a rear view of the fan of Figure 1;

Figure 6 is an exploded perspective view of the fan of Figure 1; and

Figure 7 is a scrap assembly showing part of an electric fan similar to that of Figure 1 and incorporating a humidity sensor.

Detailed description of the Invention

The invention will now be described, by way of example, with reference to the accompanying drawings.

An electric fan 1 is broadly rectangular when viewed from the front or the rear as shown in Figures 1 and 5. From the side it is again generally rectangular although with a somewhat protruding front face 3 and a rear extension 5 provided by a duct adaptor 7.

The main components of fan 1 are perhaps best illustrated in the exploded view of Figure 6, these components being front cover 9, impeller 11, hub 13, motor mount 15, motor 17, air collector 19, housing body 21 and the above mentioned duct adaptor 7. These components are all connected together essentially concentrically along an axis extending between the front cover 9 and the duct adaptor 7.

Front cover 9 includes a centrally disposed circular air inlet which itself has a central hub 25 surrounded by concentric rings 27, interlinked by generally radial webs 29.

Front cover 9 clips on to housing body 21 about their respective peripheral edges. Housing body 21 is in the form of a deep, generally rectangular wall 31 which is partly open at both ends, the front end being for securing to front cover 9 and the rear end for securing to duct adaptor 7. Within walls 31, air collector 19 is provided with a lead cover 5 which encloses the electric leads.

Together the front cover 9 and housing body 21 provide the overall housing for the electric fan 1. Within the housing the various components 11, 13, 15, 17 and 19 are located and extending rearwardly from the housing is the duct adaptor 7.

Considering the components within the housing from front to rear, impeller 11 has a central hub connector 33 which includes a fastening device for securing the impeller to adjacent hub 13. This fastening device (not shown) is released by gripping radially outwardly biased lugs 35 and pressing inwardly towards the centre of the hub connector 33.

Surrounding hub connector 33 are axially spaced apart forward and rearward rings 37 and 39. Between these rings extend peripherally spaced apart vanes 41, each vane being attached at each end to a respective ring 37, 39 and extending generally towards the centre of the impeller. Each vane 41 is broadly an elongate rectangle being curved across its width.

Hub 13 is generally of truncated dome shape having a flattened forward end 43 from the middle of which projects a circular peg 45. On opposite sides of peg 45 are apertures 47 and these, together with peg 45, are for engagement with corresponding elements (not shown) of the fastening device located within the central hub connector 33 of impeller 11.

The inner surface of rearward rim 49 and forward circular flange 51 of motor mount 15 form a labyrinth seal between the moving and stationary components of the fan.

Motor mount 15 is in the form of a cup within which is located the forward end of motor 17. Motor 17 is provided with a forwardly extending stub shaft 53 which extends through motor mount 15 to locate in the hollow peg 45 as best illustrated in Figure 4. When the motor is running, stub shaft 53 rotates and this in turn causes hub 3 and impeller 11 to rotate.

The rotation of impeller 11 causes air to be sucked into the housing of fan 1 through the inlet provided in front cover 9. Surrounding the above described components 11, 13, 15 and 17 is an inner housing in the form of an air collector 19. In this embodiment, collector 19 comprises two air collection ducts/conduits 55a and 55b (55b is not shown) each of which are substantially helically shaped channels which extend both circumferentially and rearwardly from the front of the collector 19 towards its rear. The orientation of the helical channel of air collection duct 55a is such that it directs air in a clockwise direction towards a peripherally located discharge 57a at the rear. The orientation of the helical channel of air collection duct 55b is such that it directs air in an anti-clockwise direction towards a peripherally located discharge 57b (not shown) at the rear. This air collector 19 accordingly directs air thrown radially outwardly by impeller 11 in a direction towards the rear of the fan and into duct adaptor 7. In use duct adaptor 7 will extend through a window or wall to the exterior of the building or may itself be fitted to a further conduit which extends to the exterior of the building. It may also be fitted in a duct in, for instance, a roof, ceiling or floor cavity. Appropriate circuitry and electronic components necessary to work the motor of the electric fan are provided on a circuit board that is located within a cavity (not shown) that is provided in the lower section of the rear of collector 19.

The internal housing of the above described electric fan collects the air discharging from impeller 11 and, in so doing, causes the air to expand thereby converting part of the kinetic pressure head to a static head. The extent to which such a conversion occurs depends on the system to which the blower is subjected, the system being the arrangement located either before the inlet to the device, or after its outlet or a combination of both. The level and efficiency of this conversion directly contributes to the capacity and overall efficiency of the fan as a whole.

Essentially the above described fan receives air travelling in the direction of the main axis of the device and, through the rotating part of the device, causes it to leave in a radial direction. The air leaves via a collecting chamber which modifies the static and dynamic components of pressure and provides a discrete ducted direction to the

air. The provision of multiple collecting chambers to receive air from a single rotating impeller, as provided by the above described fan, allows significant reductions in space for a given performance and without reduction in efficiency. In addition, with many smaller outlets from the multiple collecting chambers, changing the direction of the air to the axial directions is achieved much more efficiently.

The location of the key moving and other parts of the above described fan around a single axis extending from the front to the rear of the device allows for the simple disassembly of at least some of these key components. This is particularly advantageous in that it allows the fan to be very simply maintained, in particular with regard to removing grease, cleaning generally, washing and disinfecting.

Referring now to Figure 7 of the accompanying drawings, there is illustrated the central part of a fan similar to that described above. Items corresponding to those already mentioned in connection with the fan described above have been indicated with the same reference numerals. The airflow leading to discharge from the fan via duct adaptor 7 has been indicated by arrows 59. Located on the outer surface of an internal partition 61 of collector 19 is a humidity sensor 58. Provided adjacent and forward of humidity sensor 58 is a hole 63 in motor mount 15. Opposite hole 63 and provided in the wall of collector 19, adjacent and rearward of sensor 58, is a further hole 65 which is aligned with hole 63. Arrows 67 indicate the airflow through holes 65 and 63, from the main airflow indicated by arrows 59, and past and into contact with sensor 58.